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New York State Education Department
Science Division, April 2, 1909

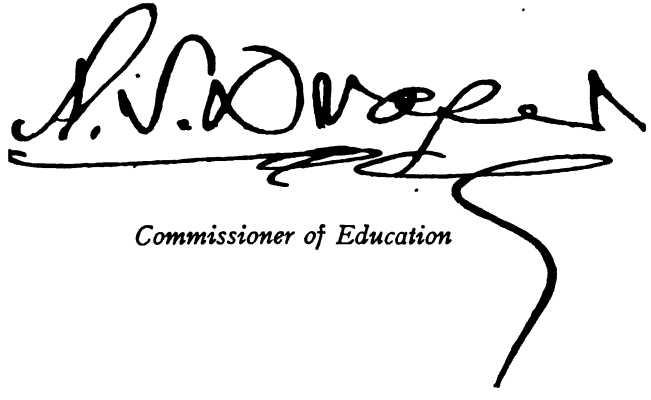
Hon. Andrew S. Draper LL.D.
Commissioner of Education

MY DEAR SIR: The State Entomologist has prepared a short bulletin on the *Control of Household Insects*. I believe this would prove of usefulness to our housekeepers, an aid to public comfort and health and I beg to submit the document to you herewith, with the recommendation that it be printed as a bulletin of the State Museum.

Very respectfully
JOHN M. CLARKE
Director

State of New York
Education Department
COMMISSIONER'S ROOM

Approved for publication April 3, 1909



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New York State Museum

JOHN M. CLARKE, Director

EPHRAIM PORTER FELT, State Entomologist

Museum bulletin 129

CONTROL OF HOUSEHOLD INSECTS

BY

EPHRAIM PORTER FELT D.Sc.

INTRODUCTION

One need not go back a decade to note a marked change in sentiment toward certain insects commonly found in homes. There have been great additions to our knowledge respecting the economic mportance of some of these insects during recent years. This bulletin aims to present in concise form the status of the principal spec.es and gives special attention to methods of controlling the pests.

There is no denying the beneficial influence of a pleasant home. It should be a place where such material benefits as protection from diseases, cleanliness and personal comfort predominate. There is deep pathos in the present situation. Many a widow protects cherished garments from "moth and rust," while the insect primarily responsible for the disruption of the home, through the introduction of the germs of typhoid fever, flies about he house unchallenged and ready, under favorable circumstances, to play its part in another tragedy.

Doubtless such deplorable conditions are preventable and our descendants of another century will stand amazed at our blind toleration of such a menace to life and happiness.

Let us seek to control the ordinary household pests; let us recast our estimation of the house fly and the malarial mosquito and gage our actions accordingly. The malevolent house fly is a constant menace to the integrity of the home. Those who have not suffered from disease germs introduced by this pest, should recognize the danger and adopt adequate precautionary measures.

Recent discoveries respecting the part played by insects in the dissemination of malaria, yellow fever and typhoid fever, read like a romance. Mosquitos as distributing agents of malaria have been suspected for many years. An active impetus was given to this suspicion through the discovery by Ross that certain Indian mosquitos harbored a malarial parasite affecting birds. It was only a step from this to human malaria. The mosquito-malarial theory took such firm hold that in 1900 Drs Low and Sambon spent the summer on the fever-ridden Roman campagna, relying entirely for protection from malaria upon flimsy mosquito netting. Their field test was further confirmed by the shipment of malarial-infected mosquitos to London, where they were allowed to bite Dr Patrick Manson's son, who in due time came down with the disease though residing in a nonmalarious section.

The deadly, justly dreaded "yellow jack" has likewise been traced to its lair through the heroism of a few devoted scientists. Volunteers lived in a fever stricken locality with no protection from infection other than the frail mosquito bar. They even slept in beds soiled by fever patients for the sake of demonstrating beyond question that the disease was not infectious. Drs Carroll and Lazear went further and allowed themselves to be bitten by infected mosquitos. Both contracted the disease, the latter losing his life on the altar of scientific investigation. This was true heroism. All honor to these martyrs. Theirs was not a useless sacrifice. Before their time, a yellow fever outbreak meant the loss of hundreds or thousands of lives, simply because there was no known adequate method of preventing the disease. Prolonged arbitrary and wasteful quarantines were maintained. Thousands fled from infected districts. The horrors of the shotgun quarantine prevailed. The control of the yellow fever epidemic of 1905 in New Orleans is a most striking testimony to the value of the recent discoveries regarding this disease. This outbreak was handled as a mosquito-borne infection and for the first time

the disease was stamped out before cold weather and with comparatively little loss in either life or property.

The Spanish-American War has resulted in a material addition to our knowledge respecting the part flies may play in the spread of typhoid fever, an infection costing the country $350,000,000 annually, it is estimated. The conditions in the army camps were such as to result in the unquestioned indictment of the ordinary house fly as the chief agent, under such conditions, in spreading the deadly germs of typhoid fever and other grave intestinal diseases. These conclusions have been supported by thoroughly competent investigators working under quite varied conditions. There is no questioning the deadly potentialities of the hitherto supposedly harmless house fly, if it has access to disease-infected discharges, a condition altogether too frequent in country districts.

DISEASE CARRIERS

Typhoid or house fly[1]

Known and tolerated from time immemorial, this insect is more than a nuisance. It is a menace to life under certain conditions. It is far from being a necessary evil, since the adoption of comparatively inexpensive methods is all that is essential to bring about an enormous reduction in its numbers.

The fly as a disease carrier. The experience of recent years, particularly that of the Spanish-American War, has called attention in a most forcible manner to the part flies may play in conveying typhoid fever and other affections of the digestive system. Typhoid fever affects about 250,000 Americans annually, 35,000 of the cases proving fatal. There is no denying the important part played by water in carrying this infection, nevertheless the common house fly is a most efficient agent in this work. Virulent typhoid bacilli have been found on the legs and within the body of this insect, persisting in the latter case, for 23 days. A number of serious outbreaks have been observed by competent physicians in various parts of the country, and in each instance the infection through a common water or food supply did not afford a satisfactory explanation. Similarly, the cholera bacillus has been found in large numbers on flies, has been recognized in fly specks 17 hours after feeding and as late as four days, and infected flies have carried the disease germs to milk. It is equally certain that flies may convey the germs responsible for certain forms of diarrhoea and

[1] Musca domestica Linn.

other intestinal disorders. It is more than probable that flies play an important part in causing the heavy mortality among bottle-fed babies, the proportion of deaths between these and breast-fed babies being as 25 to 1. It has been shown that flies may ingest, carry and discharge tubercular bacilli, thus aiding materially in spreading tuberculosis. Furthermore, it is held that flies may, under certain conditions, convey plague, trachoma, septicemia, erysipelas, leprosy, and there are reasons for thinking that this insect may possibly be responsible for the more frequent

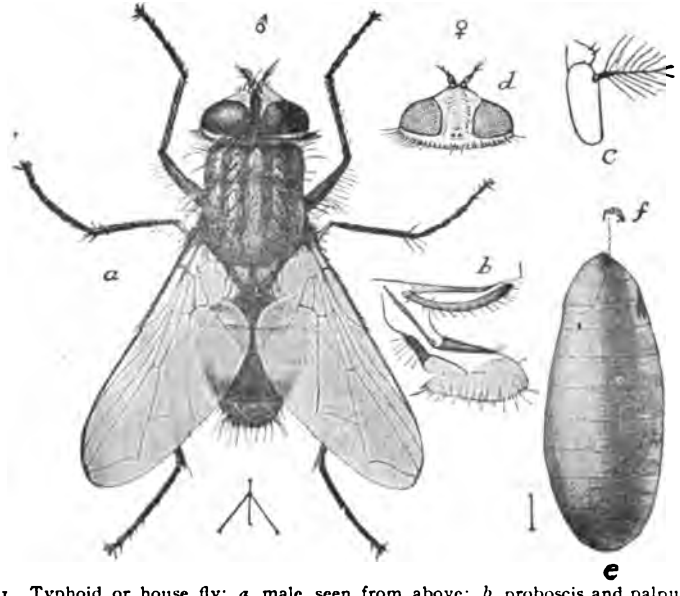

Fig. 1 Typhoid or house fly: *a*, male, seen from above; *b*, proboscis and palpus from the side; *c*, tip of the antenna; *d*, head of female; *e*, puparium; *f*, the anterior breathing-pore or spiracle, all enlarged. (After Howard & Marlatt, U. S. Dep't Agric. Div. Ent. Bul. 4. n. s. 1896)

new cases of smallpox occurring in the near vicinity of a hospital. The eggs of certain intestinal parasites, such as those of the tapeworm, may be swallowed by the fly and passed uninjured.

Methods of carrying diseases. The most common and dangerous infections conveyed by the house fly are typhoid fever, other intestinal disorders, including those affecting young children, and tuberculosis. Typhoid germs may be discharged from the human system several weeks before diagnosis is possible, continue in numbers 6 to 8 weeks after apparent recovery, and in exceptional cases may persist during a period of several years. There are authentic

records of a patient distributing these germs for 17 years and being the incipient cause of 13 cases during 14 years of that period. Even the urine of patients may contain active typhoid bacilli. Similarly, the germs producing other intestinal disorders are discharged from the system though presumably not persisting for such extended periods. It is well known that the germ causing tuberculosis is abundant in the sputum of patients.

The house fly subsists entirely upon fluids and feeds with apparently equal gusto upon fresh manure, decaying vegetable matter, sputum or the daintiest culinary preparations. It is only necessary for discharges from patients suffering from typhoid fever or other intestinal diseases to be exposed in open vessels or poorly constructed privies in order to secure the spread of the infection. The hairy legs are fouled with thousands of deadly bacilli and countless numbers are swallowed. Shortly thereafter the flies may appear in the house and incidentally contaminate the food, to the great peril of the consumer, with the germs adhering to the limbs and those deposited with undiminished virulence in the familiar fly specks. This, while disgusting and abhorrent to every sense of decency, occurs repeatedly in nature and is apparently ignored by the masses, despite the deadly peril thus incurred.

Habits. The house fly breeds by preference in horse manure, though it lives to a limited extent in cow manure and miscellaneous collections of filth, especially decaying vegetable matter. The flies deposit their eggs upon manure and similar material, the young maggots hatching in less than 24 hours and, under favorable conditions, completing their growth in 5 to 7 days. The maggots then transform to an oval, brown, resting or pupal stage, remaining in this condition from 5 to 7 days. The life cycle is therefore completed in 10 to 14 days, the shorter period being true of the warmer parts of the year, particularly in the vicinity of Washington, D. C. One fly may deposit 120 eggs, and as there may be 10 or 12 generations in a season, it is not surprising that this insect should become extremely abundant by midsummer. Calculations show that, under favorable conditions, the descendants from one fly might at the end of a season reach the stupendous number of over 190 quintillion. It has been estimated that 1200 house flies might be bred from a pound of manure, and at this rate a good load would produce two and one half million. Fortunately, breeding is confined to the warmer months, only a few flies wintering in houses in a more or less dormant condition.

Ordinarily, flies do not travel a great distance and, in most instances, probably breed within 300 to 500 feet of places where they are extremely abundant. Butcher carts, grocery wagons and electric or steam cars carrying more or less exposed meat and other supplies attractive to flies, may become important agents in the dissemination of disease, since it is only necessary for these vehicles to load where conditions are favorable for fly infection and we may have a mysterious outbreak of disease at some distance from the source of trouble.

Sanitary and control measures. It is perhaps needless to add, in view of the foregoing, that the greatest care should be taken to exclude flies from the sick room, especially in the case of contagious diseases. The flies are not only annoying to the patient but may aid in carrying the disease to others. The proper disposal of infected discharges, such as those from typhoid patients, should never be neglected, and under no conditions left where flies may gain access to the infection.

All food, particularly that eaten without having been cooked, should be carefully protected from flies by the use of screens. This is especially true of milk, since it affords a favorable medium for the multiplication of certain disease germs. It applies to dealers in food supplies as well as to the home. An important step toward better sanitation would be taken if the public refused to patronize provision stores, restaurants and hotels overrun by flies.

A large reduction in the number of house flies found in most places is thoroughly practical. This can be best effected by doing away with conditions favorable to the unrestricted multiplication of this pest. The first step is to prevent flies from breeding in horse manure and other waste products from the stable. All manure should be placed in a fly-proof receptacle or the accumulation treated daily with small quantities of chlorid of lime. If the manure is removed from the stable at intervals of seven days and spread upon the field, there will be comparatively little breeding. One of these measures can be applied to every stable in cities and villages. The farmer, if unable to carry out any of the preceding suggestions, will find a large measure of relief from the fly nuisance, if the manure is stored in tight, practically fly-proof cellars, such as can be easily constructed with the modern concrete foundation. Flies breed but little in darkness, and the writer has known of barns comparatively free from flies, simply because the manure was stored in the darker parts of a large barn cellar.

The treatment of manure, described above, should be supplemented by care in preventing the accumulation about the premises, of decaying organic matter such as fruit, table scraps, etc. Swill barrels should always be provided with tight covers and care exercised that there be no leakage or an accumulation of fly-breeding material about the barrel. The old-fashioned box privy should be abolished unless it is conducted on the earth closet principle and the contents kept covered with lime or dry earth, so as to prevent both the breeding and infection of flies. The modern water-closet and cesspool is by far the best and safest solution of this last named difficulty. Such conveniences—one might well term them necessities — are no more costly than a long run of fever with its attendant suffering and occasional death. The presence of numerous flies about the dwelling may be construed as indicating a nearby, usually easily eliminated, breeding place.

It will be found in practice that some flies are very apt to exist in a neighborhood even after the adoption of rigid precautions. They should be kept out of houses, so far as possible, by the use of window and door screens, supplemented by the employment of Tanglefoot or other sticky fly paper. This, though somewhat disagreeable, is much to be preferred to the use of poisonous preparations likely to result in dead flies dropping into food. Prof. C. P. Lounsbury, Government Entomologist of South Africa, suggests, in addition to the above, putting fresh pyrethrum powder upon window sills and supplementing this by the judicious use of an insect net.

The control of this pest is of great importance to the community. Individual effort in this direction should be strengthened and sustained by all officials charged with protecting the public health. The Health Department of Washington, D. C. has already promulgated excellent ordinances against the fly pest. Similar action should be taken by health officials in our municipalities and villages.

Fruit flies

These light brown flies, only about ⅛ of an inch long, are most commonly found about the pomace of cider mills and on overripe or partly decaying fruit. They are attracted by fermented liquids, such as wine, cider, vinegar, beer, and may frequently be observed on the sides of jars containing preserved fruits. There are two species[1] which appear to be most abundant. It is very difficult

[1] Drosophila ampelophila Loew and D. amoena Loew.

to keep these insects out of houses on account of their small size. Dr Howard has listed these forms as likely to be disease carriers.

These little insects ordinarily enter the house rarely unless attracted by overripe or canned fruit. The latter should be hermetically sealed, making it safe from injury, and stored in the cellar or other place comparatively inaccessible to the flies, as soon as convenient. These small flies can be easily destroyed with fresh pyrethrum powder.

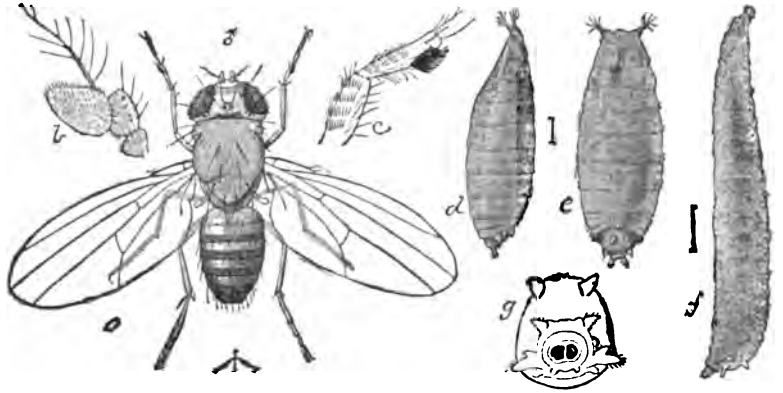

Fig. 2 Fruit fly: *a*, adult fly; *b*, antenna; *c*, base of tibia and first tarsal joint; *d*, puparium, side view; *e*, same, dorsal view; *f*, larva; *g*, anal segment of same; *a*, *d*, *e*, *f*, much enlarged; *b*, *c*, *g*, still more enlarged. (After Howard, U. S. Dep't Agric. Div. Ent. Bul. 4. n. s. 1896)

Malarial mosquito[1]

This insect has always been with us. It is only recently that its connection with the spread of malaria has been established beyond question, though there has long been a suspicion that some mosquitos might be responsible for this disease.

Infect on by malaria. Medical men, best qualified to pass upon the question, unhesitatingly affirm that certain mosquitos are responsible for the dissemination of this malady. Malaria, like some other diseases, is caused by a specific germ. It is peculiar in that it has to pass through certain changes within the body of the mosquito before it can develop successfully in the human system. Moreover, malarial mosquitos are harmless until they have become infected by biting some person suffering from this disease. These germs may be carried by man in a latent con-

[1]Anopheles maculipennis Meign.

dition for years. This is especially true of Italians. The sequence of events may be briefly summarized as follows: A female mosquito bites a person having malarial germs in his blood. The malarial parasites enter the walls of the mosquito's stomach, undergo certain changes therein, and in from 7 to 14 days make their way to the salivary glands and are then ready to enter the system of the next person bitten. These germs then undergo a series of changes, and if the person is not immune a more or less severe case of malaria develops. So far as known, the malarial mosquito, and that only, can carry this infection. The connection between malaria and extensive excavations has long been recognized, though it is only recently that a satisfactory explanation of this condition has been advanced. Malarial mosquitos breed in large numbers in pools in and about excavations. Italians are our principal excavators. Most of them have suffered from malaria and have the disease germs

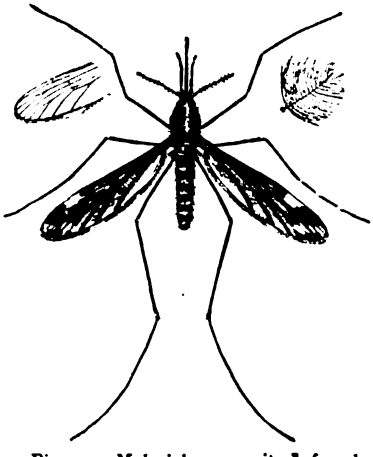

Fig. 3 Malarial mosquito, female, with male antenna at right and wing tip showing venation at left. (After Howard, U. S. Dep't Agric. Div. Ent. Bul. 25. n. s. 1900)

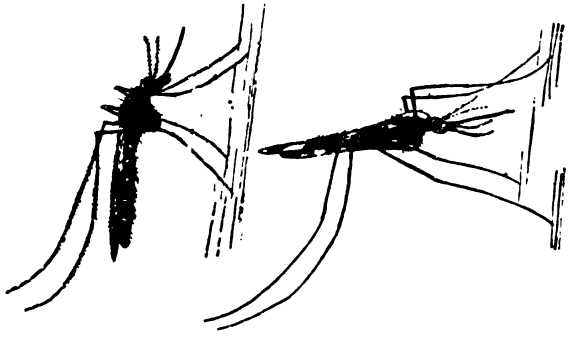

Fig. 4 Common and malarial mosquitos at rest, the latter to the right. (Reduce from Howard, U. S. Dep't Agric. Div. Ent. Bul. 25. n. s. 1900)

in their systems. The malarial mosquito, breeding in large numbers about recent excavations, derives its infection from the Italians and then, if opportunity allows, inoculates Americans. We therefore frequently have exceptionally severe outbreaks of malaria

following extensive excavations. This is exactly what would be expected if the above statements are true.

Habits. The appearance and habits of the malarial mosquito are important if we wish to avoid malaria. The malarial mosquito is easily recognized by its spotted wings and, in particular by the characteristic resting position, the beak and the body being in almost a straight line and at a considerable angle to the supporting surface. On the other hand, our ordinary mosquitos do not have spotted wings and when at rest the beak and the body form an obtuse angle, the body being approximately parallel with the supporting surface. The wriggler of the malarial mosquito occurs in grassy pools, beside streams and is frequently very abundant in collections of water in and about recent excavations. The wriggler of the malarial mosquito is easily recognized by the absence of a conspicuous air tube, by its resting in a horizontal position just beneath the surface film, and the usually bright or dark brown and greenish colors. The wrigglers of the common mosquito, conversely, have a large air tube at the posterior extremity, invariably rest with the body at a considerable angle to the surface of the water and are a dull whitish or yellowish white. The malarial mosquito breeds more or less during the warm months of the year, the spotted-winged adults wintering in any shelter, frequently in houses and occasionally flying in midwinter. The capture of chilled specimens on snow banks in early spring is not unusual.

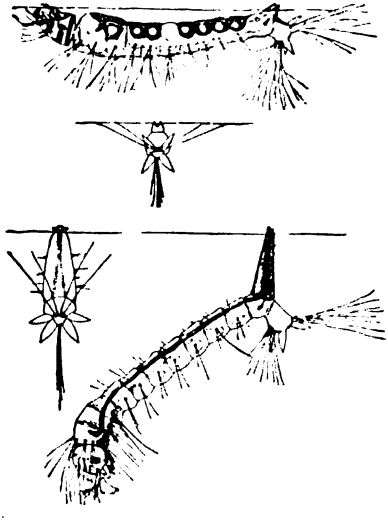

Fig. 5 Characteristic feeding position of malarial mosquito wriggler in upper figure, and that of the common mosquito in lower figure. (After Howard, U. S. Dep't Agric. Div. Ent. Bul. 25. n. s. 1900) ×

Control measures. Malarial outbreaks may be prevented or controlled in two ways. The malarial mosquito is very local in its habits. It is comparatively easy, by draining breeding pools and treating those not easily drained, with oil, to eliminate the mosquito and thus do away with all danger of infection. This is practicable in most cases and in sections where malaria is more or less prevalent, is the only course to pursue.

The malarial mosquito is widely distributed in the North and there is always a chance of an outbreak following the appearance of parties suffering from malaria or having the parasite in their blood, as for example, Italians. The advent of either in a neighborhood should be preceded if possible by extraordinary activity in draining or treating breeding places in order to destroy as many of the insects as possible and thus reduce the danger of infection. Methods of value in controlling common mosquitos will be equally serviceable in checking this disease carrier.

Yellow fever mosquito[1]

This, though a southern species, is of interest owing to its great economic importance. It is a dark brown form, marked with strongly contrasting silvery white, and is frequently designated as the day mosquito in the South.

Yellow fever carrier. This insect appears to be the only method by which yellow fever may be conveyed from one person to another. As in the case of the malarial mosquito, the yellow fever mosquito is harmless until it has become inoculated with the germs by biting a yellow fever patient, and even then some 12 days must elapse before it can convey the infection. As a result of the recent discoveries relating to this insect, the control of a yellow fever outbreak means a strenuous, well sustained campaign against this insect, supplemented by the exercise of special care to prevent mosquitos gaining access to yellow fever patients.

Habits and control. The yellow fever mosquito appears to have in the South much the same habits as our house mosquito in the North. It displays a marked preference for the water in cisterns, tanks and similar places; consequently measures of value in reducing the house mosquito will prove equally serviceable in controlling this much more dangerous southern species.

ANNOYING FORMS

Cluster fly

This interesting species[2] has received its popular name because of the large clusters occasionally found in autumn in houses. It is easily distinguished from the rather closely related house fly by the black thorax covered rather thickly with tawny hairs frequently

[1] Stegomyia calopus Meign.
[2] Pollenia rudis Fabr.

inclining to a grayish shade. The young of this species live about the roots of grasses and there is a record of its having been reared from cow dung. Clusters of this insect can easily be destroyed by dusting the flies liberally with fresh pyrethrum powder. The insecticide may be molded into moist cones and burned if preferred. The stupefied flies, in either case, should be swept up and burned.

Wasps and hornets

Fig. 6 Wasp enlarged. (After Riley)

The paper wasp[1] and the common wasp[2] frequently occur about buildings and are of considerable service in destroying flies. Occasionally, if exceptionally abundant, they may become a nuisance on account of the danger from stinging. These insects can easily be excluded by the use of screens and in case of their being excessively abundant the nests should be found and the inmates destroyed at night with chloroform or bisulfid of carbon.

House or rain barrel mosquito[3]

This modest, brown, though by no means retiring mosquito, hardly needs an introduction. Its suggestive song is so well understood that we instinctively prepare for the inevitable. This mosquito takes advantage of man at every possible opportunity, while we tamely submit to a series of annoyances which could be eliminated at a less expenditure of energy than is necessary to endure repeated trials of patience with a reasonable degree of fortitude.

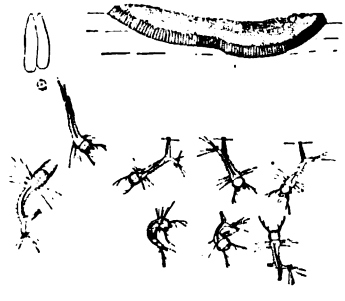

Fig. 7 House mosquito. Egg mass with enlarged eggs above and at the left; young wrigglers below. (Reduced from Howard, U. S. Dep't Agric. Div. Ent. Bul. 25. n. s. 1900)

Habits. This insect winters in small numbers in houses or other shelters, the females depositing clusters of eggs upon standing water on the approach of warm weather. Breeding may continue

[1] Vespa germanica Fabr.
[2] Polistes sp.
[3] Culex pipiens Linn.

under favorable conditions till checked by frosts in the fall. This domestic pest displays a marked partiality for water in rain barrels, cisterns, defective eave troughs, old wooden buckets, tin cans or similar receptacles. The black eggs are deposited in raftlike masses of some two to four hundred, and the entire development to the adult may occur within 14 days. One rain barrel may produce thousands of mosquitos and provide an abundance of these ubiquitous annoyances throughout a season.

Control. This species, like a number of other mosquitos, is quite local in habit and its presence may be construed as an indication of nearby breeding places. The elimination of useless barrels, tin cans, etc. will accomplish much toward reducing the numbers of this pest, and this should be supplemented by attention to gutters and eave troughs to see that they have not become bent or clogged so as to afford breeding places. Rain barrels and cisterns, if a necessity, may be rendered innocuous by covering them closely, even though nothing more substantial than mosquito netting be employed. Should this latter be undesirable, the surface may be kept covered with a film of kerosene, without detriment to the employment of the water for domestic purposes, provided the water be drawn from the lower part of the vessel.

Salt marsh mosquito[1]

The salt marshes, as might be presumed, present peculiar conditions and these are accompanied by a corresponding variation in animal life. Those at all familiar with marsh conditions have learned by experience about the large, voracious swarms of mosquitos which may occur in such sections.

Habits. The salt marsh mosquito is typical of several forms which breed by preference in brackish water. The short tubed, dark colored wrigglers are found here and there in pools, being by far the most numerous within two or three hundred feet of the high land, this area being that portion of the marshes flooded only by high tides. These more or less regular overflows of water result in numerous eggs hatching and the production of ravenous hosts of mosquitos, easily recognized by their white banded legs, beak and body, the latter in addition, bearing a conspicuous longitudinal white stripe. These insects differ greatly from our house mosquito, in that they fly considerable distances, there being authentic records of their having been found 40 miles from the nearest available breeding place. Occasionally hosts of these

[1] *Culex sollicitans* Walk.

insects invade New York city to the great discomfort of the residents.

Control. The control of this species is practicable though at the outset it appears somewhat difficult. All that is necessary is to provide drainage so that pools of water will not stand more than a few days. This is accomplished by running narrow ditches within about 25 feet of the headland and 40 or 50 feet apart, all being connected with some tidal creek so that they are flushed out twice daily. The walls of the ditches should be perpendicular and the bottom at a uniform level. Experience has shown it inadvisable to have the walls sloping or to attempt to secure a uniform

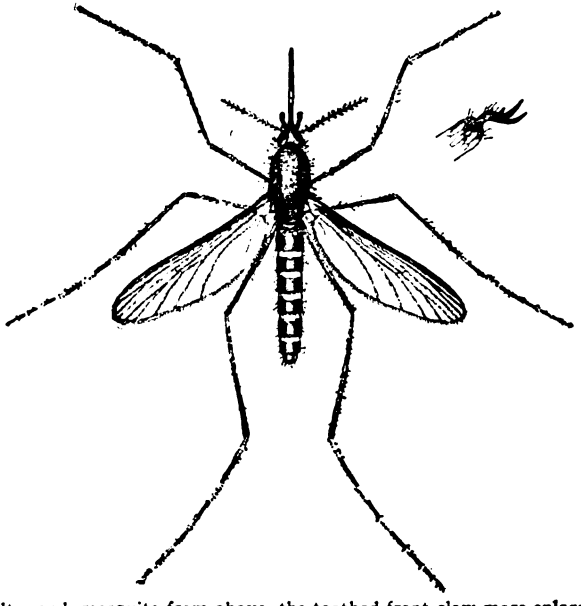

Fig. 8 Salt marsh mosquito from above, the toothed front claw more enlarged. (After Howard, U. S. Dep't Agric. Div. Ent. Bul. 25. n. s. 1900)

pitch, since the latter almost invariably results in pools not reached by the daily tides. This work has been conducted on an extensive scale in the vicinity of New York city with most gratifying results. Several types of ditching machines are in use and the work is comparatively inexpensive.

The elimination of mosquito breeding places on the salt marshes may sometimes be accomplished by the use of tidal gates and a series of drains. This method, while thoroughly effective, belongs to the domain of land development rather than to that of insect subjugation. The additional cost in many cases may be more than met by the increased value of the marshes treated

House fleas

The cat and dog flea[1] is the species most usually abundant in houses in New York State, judging from the specimens submitted with complaints. This species, as its common name indicates, occurs indiscriminately upon both the cat and the dog and may be found about their sleeping places. The minute, white eggs are laid mostly in such places. The slender, active larvae feed upon organic matter in cracks and crevices, and are most numerous about the sleeping places of domestic animals The flea is a prolific insect. The closing of a dwelling for several weeks or more in warm weather affords almost ideal conditions for rapid multiplication, and more than once householders have been surprised

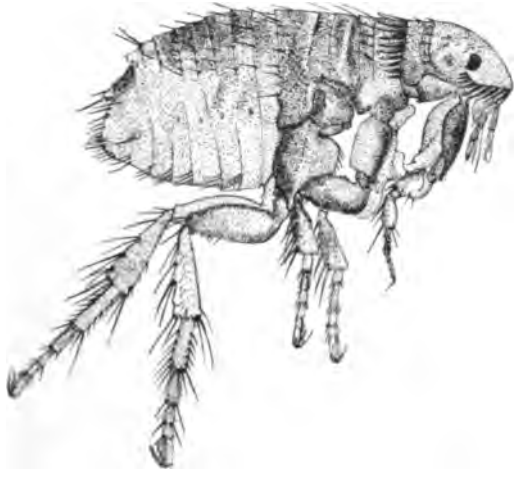

Fig. 9 Cat and dog flea, seen from the side, enlarged. (Original)

on returning to find the home overrun by these active, annoying pests. A rat flea is an important factor in the spread of bubonic plague.

Control measures. Fleas are very likely to occur on cats and dogs and if these animals must be retained in the home, care should be exercised to keep their sleeping places clean. Provide the animal with a mat or blanket upon which it may sleep. This mat should be taken up frequently, shaken and the collected dust beneath burned. This is a most effective method of preventing the multiplication of these insects. An animal known to

[1] Ctenocephalus canis Curtis.

be infested with fleas should have a quantity of fresh pyrethrum powder rubbed into the hair. This will stupefy the pests, causing them to drop off and then they may be swept up and burned. Dusting hosiery with pyrethrum powder has been found very effective in preventing flea bites in situations where such precautions are advisable.

It is frequently very difficult to deal with a bad infestation, due to the impossibility of getting at the breeding places or destroying all of the fleas at one time. Dr Henry Skinner of Philadelphia states that he has successfully destroyed fleas in a badly infested room, by sprinkling the floor liberally with about 5 pounds of flake naphthalene and closing the room for 24 hours. The acrid fumes destroyed the fleas and inflicted no material injury. There is no danger in this procedure and we earnestly commend it to those troubled by this pest. Fumigation with hydrocyanic acid gas, described on page 42, where practical, is a most satisfactory method of dealing with this condition.

A sparse infestation has been handled satisfactorily, according to Dr Howard, by placing a white cloth, like a pillow case, in the middle of the floor. The fleas, attracted by the color, jump on the cloth and may then be captured with a wet finger and put into water.

Bedbug[1]

The brown, oval, flattened, malodorous insect so generally designated by the above name, is too familiar to require description.

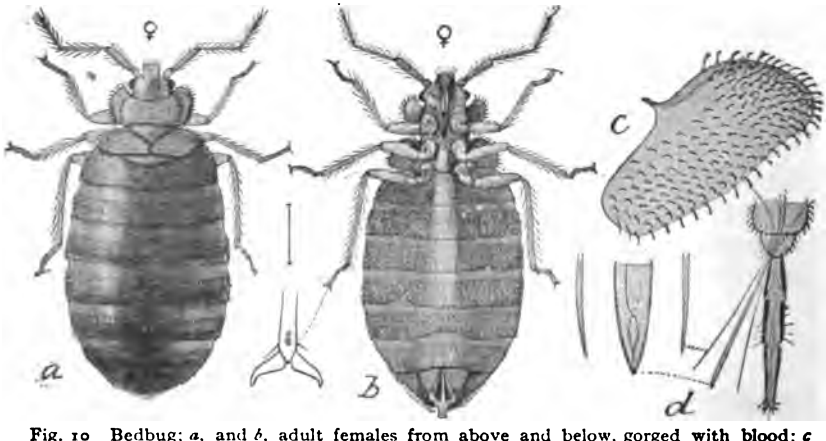

Fig. 10 Bedbug; *a*, and *b*, adult females from above and below, gorged with blood; *c* and *d*, structural details. (After Marlatt, U. S. Dep't Agric. Div. Ent. Bul. 4. n. s. 1896)

[1]Cimex lectularius Linn.

It is especially likely to be abundant in old houses where cracks and crevices abound, and its continuance there n :s favored by the old style wooden bedstead with its numerous shelters The occurrence of this pest in a home is not necessarily a reflection upon the ability of the housewife. Its continuance there may be the occasion of grave reproach. Bedbugs are very liable to occur on boats, are occasionally found in sleeping cars and are said to be much more common in the Southern than in the Northern States.

Habits. This insect, as many can vouch for by personal experience, is nocturnal in habit. Recent experiments show that it may feed under certain conditions on mice as well as upon man. This habit,[1] should it prove to be general, accounts for cases where bedbugs are found very abundant in houses which have been uninhabited for some time. Another species[1] occurs in swallows' nests and occasionally invades adjacent living rooms. It appears to live almost exclusively upon birds, though a third form,[2] found on chickens, has been known to suck human blood, but not under natural conditions.

The oval, white eggs of the bedbug are deposited in cracks and crevices in batches of 6 to 50 or thereabouts. The yellowish white, nearly transparent young hatch therefrom in a week or 10 days. Experiments have shown that about 11 weeks are necessary for the young insects to attain maturity, though the period is probably greatly modified by the degree of warmth and the abundance of food. It is said that ordinarily only one meal is taken between each of the five molts preceding the attainment of maturity. Full-grown bugs at least are able to endure long fasts with apparently no inconvenience. It has been stated that the bedbug may serve as a carrier of certain diseases.

Control measures. Cracks and crevices, loose wall paper and the old wooden bedsteads afford ideal hiding places for this disgusting pest. The modern tight construction of both floors and walls, and iron or brass bedsteads reduce the retreats of this species to a minimum and greatly facilitate its control.

The insect can be controlled in the older type of dwelling only by extreme vigilance. Cracks and crevices should be stopped so far as possible, and the joints of the old-fashioned bedstead treated liberally with benzine, kerosene or similar oils. Hot water can be

[1] Cimex hirundinis Jenyns.
[2] Cimex columbarius Jenyns.

employed for cleansing bedsteads where this treatment seems preferable. Corrosive sublimate is frequently used, though a deadly poison and should be employed with great caution. The daily inspection and the destruction of bugs found on the bed and bedding soon results in eliminating the pest un'ess the building affords comparatively inaccessible retreats, as, for example, a very defective floor.

A room badly infested by this pest might well be thoroughly fumigated with brimstone; 2 pounds of sulfur are advised for each thousand cubic feet of space, the treatment being continued at least 24 hours if possible. The sulfur candles now manufactured are excellent for this purpose. A more effective though much more dangerous method is the employment of hydrocyanic acid gas, directions for the use of which are given on page 42. This latter is especially serviceable where entire buildings are badly infested.

It may be comforting to know that the bedbug has active enemies in the little red ant and also cockroaches. Unfortunately these insects are serious nuisances in the household and hardly more welcome than the pest under consideration.

Bedbug hunter

Fig. 11 Masked bedbug hunter or kissing bug, from above, about twice natural size. (After Howard, U. S. Dep't Agric. Div. Ent. Bul. 22, n. s. 1900)

This species[1] occasionally occurs about houses and with one or more allies was widely noticed by newspapers in 1898 under the name of kissing bug. This brownish or black insect is about ¾ of an inch long and has somewhat the same shape as the malodorous squash bug of the garden. It is beneficial, since it preys upon insects. The grayish, sprawly legged young are unusually interesting on account of their being covered with particles of lint. This gives them a nondescript appearance and undoubtedly is of service in enabling them to creep up unobserved upon their prey.

[1] Opsicoetus personatus Linn.

House centipede[1]

This light brown, rapidly running, sprawly legged centipede arouses more or less aversion and terror through apprehension. Like other centipedes, it is capable of inflicting a somewhat poisonous bite though, as a rule, it is only too glad to escape. The house centipede has become well established in the dwellings of Albany, N. Y. and is presumably more or less abundant in other cities of the State. It is beneficial in that it is known to prey upon house flies, cockroaches and other insects. Its presence in a house should be welcomed, since it is capable of inflicting no injury aside from a somewhat poisonous bite, the latter being extremely rare.

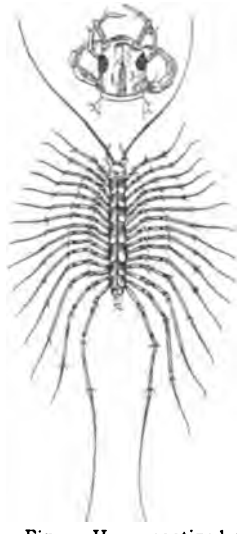

Fig. 12 House centipede; seen from above, enlarged, the head still more enlarged. (After Wood)

FABRIC PESTS

Clothes moths

The small, white caterpillars of these insects, frequently in a cylindric, webbed case, are very different from the young of the

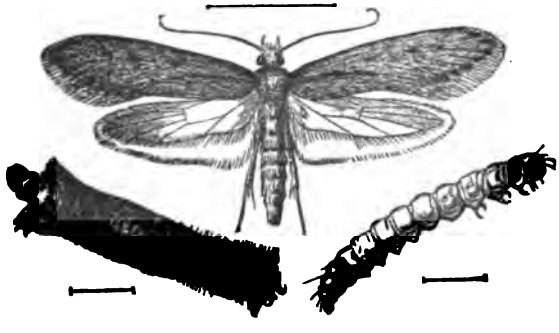

Fig. 13 The common case-making clothes moth; adult; larva and larva in case; enlarged. (After Riley)

carpet beetles noticed on page 25, one of which is frequently referred to as the Buffalo clothes moth. The true clothes moths

[1] Scutigera forceps Raf.

are small, grayish yellow moths or millers, indistinctly dark spotted and having a wing spread of less than half an inch. The progeny of not all small moths are injurious to fabrics, though several such destructive species occur in this State.

Description and habits. The most common form in New York State is known as the case-making clothes moth[1] easily recognized in the immature stage by the cylindric case which the small caterpillar drags around as it moves from place to place.

The webbing or southern clothes moth[2] is stated to be the more abundant and injurious species in the latitude of Washington though it occurs farther north. This species is about the same size as the preceding and has uniformly pale yellowish wings. The young or caterpillar does not construct a case but lines its runways with fine silk. This destructive caterpillar feeds on a variety of animal materials, having been found in woolens, hair, feathers and furs, and is frequently a troublesome pest in museums.

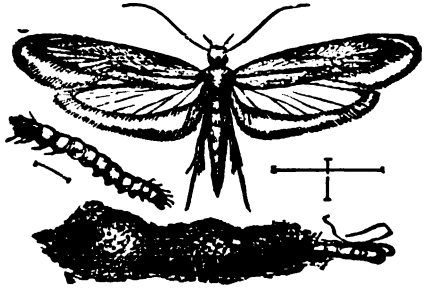

Fig. 14 Webbing or southern clothes moths: adult, larva, cocoon and empty pupal skin; enlarged. (After Riley)

The tapestry moth[3] is rare in this country and is larger than either of the other two, having a wing spread of about ¾ of an inch. The base of the forewings is black, the outer portion being a variable creamy white. This larger species displays a marked preference for the heavier fabrics, such as carpets and horseblankets and may be found in felting, furs, skins, carriage upholstering, etc.

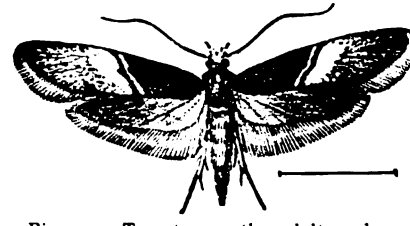

Fig. 15 Tapestry moth: adult, enlarged. (After Riley)

Control measures. Clothes moths, like carpet beetles, fleas and some other household pests, thrive best in situations where there is relatively little disturbance. Clothing used almost daily and other fabrics subject to frequent handling, brushing or sweeping

[1] Tinea pellionella Linn.
[2] Tineola biselliella Hum.
[3] Trichophaga tapetzella Linn.

are relatively immune from injury. Woolens and furs are most likely to be damaged while in storage during warm weather. These, before being laid away, should be thoroughly aired, brushed and carefully examined for the presence of the destructive larvae. Then they should be packed in cedar chests or tight boxes, preferably with some naphthalene or camphor, as these latter materials are of some service as repellents. A very effective and cheap method of storing articles for the summer is to put them in tight pasteboard boxes and seal the covers firmly with strips of gummed paper.

Valuable furs and similar articles are frequently deposited with storage companies. Experiments conducted under the direction of Dr Howard, Chief of the Bureau of Entomology, have shown that all danger of injury by clothes moths and their associates may be obviated by keeping the temperature at about 40° Fahrenheit. This is sufficiently low so that insects, even if present, will remain in a dormant and therefore harmless condition.

Occasionally a clothespress becomes badly infested by clothes moths. All garments should then be removed, aired, thoroughly brushed and care taken to destroy any larvae which may not have been dislodged by this treatment. The clothespress itself should be thoroughly brushed and cleaned. These measures should afford relief. It is a very poor plan to have in the attic or some unused part of the house miscellaneous woolens or other materials in which the pests can breed unrestricted, as such places are likely to serve as centers for the infestation of more valuable articles. Methods of fumigating are briefly discussed on pages 27, 42.

Spraying with benzine or naphtha two or three times during warm weather is advisable for the purpose of preventing injury to cloth-covered furniture, cloth-lined carriages and similar articles in storage or unused for extended periods. Care should be exercised to prevent the inflammable vapor of these oils gaining access to fire of any kind.

Carpet beetles

Housekeepers of Albany, N. Y., at least, are seriously troubled by carpet beetles. These destructive insects, it will be seen by referring to page 23, are very different from the clothes moths though operating somewhat in the same manner.

Description. The Buffalo carpet beetle[1] is a stout, oval beetle ⅛ of an inch long or less and easily recognized by its black and

[1] Anthrenus scrophulariae Linn.

white or yellowish white and red mottled wing covers. The red markings form an irregular line, with three lateral projections on each side, down the middle of the back. The common name Buffalo carpet beetle is suggestive of the shaggy, stout grub or larva, some ⅛ of an inch long, found working in carpets, more generally along seams or cracks in the floor.

The black carpet beetle[1] is a more slender, black or brownish beetle somewhat larger than the oval Buffalo carpet beetle, though rarely attaining a length of 3/16 of an inch. It is peculiar on account of the greatly produced terminal antennal segment in the male. The slender, reddish brown grub, some quarter of an inch or more in length, is easily distinguished from that of the Buffalo carpet beetle by the long, brushy tail of reddish hairs and the sparse clothing of the tapering body.

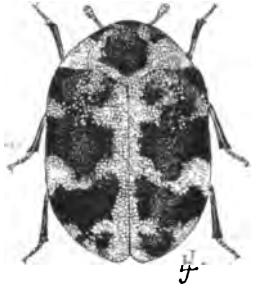

Fig 16. Buffalo carpet beetle, seen from above, enlarged (Original)

Habits. Both of these carpet beetles are rather common on flowers the latter part of May and early in June and may be brought into houses therewith. They also occur on windows in early spring, are found in the fall and occasionally in the winter. Both play possum when disturbed. The eggs of the Buffalo carpet beetle are deposited in convenient places and the young grubs develop quite rapidly. It is probable that there are not more than two generations in the North though the insects are active in warm houses throughout the year. The black carpet beetle has very similar habits though the development of its grub appears to be much slower. This latter insect is known to feed upon feathers and has been reared in flour and meal. Woolens are more liable to injury than other fabrics.

Control measures. Obviously it is advisable to destroy the beetles found about houses before they have had an opportunity of laying eggs. It is desirable to avoid bringing the pests into the house with flowers. Both of these insects breed in organic matter, presumably in outbuildings or outdoors, as well as within, fly to the flowers and may then, in the case of the Buffalo carpet beetle at least, be carried into dwellings before eggs[2] are deposited. The

[1] Attagenus piceus Oliv.

[2] Professor Slingerland, Rural New Yorker, 1896, 55:582. records obtaining eggs from Buffalo carpet beetles taken on flowers.

substitution of rugs or matting for carpets is advised in localities where the pests are destructive.

Infested carpets should be taken up and thoroughly cleaned, and if badly infested, sprayed with benzine. This latter should invariably be done outdoors, owing to the extreme inflammability of this oil. Local injury can frequently be stopped by passing a hot iron over a damp cloth laid on the affected part of the carpet. The steam penetrates the fabric and destroys the pest in its retreat. The danger of subsequent injury can be largely avoided by filling all cracks and crevices in poorly constructed floors with putty or plaster of paris. Laying tarred paper under a carpet has been frequently advised as a preventive.

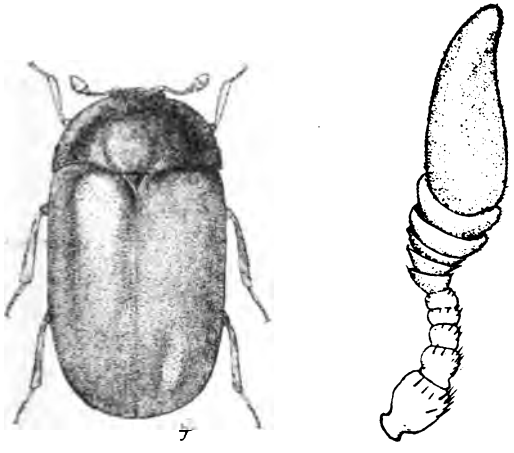

Fig. 17 Black carpet beetle, seen from above, enlarged; antenna of the male, st more enlarged (Original)

These insects can undoubtedly be destroyed by fumigation with burning sulfur, bisulfid of carbon and hydrocyanic acid gas. The first named is frequently employed and though the fumes are very pungent, liable to blacken silver and cause other damage, particularly if considerable moisture is present, it is one of the safest fumigants. Bisulfid of carbon, on account of its inflammability, is hardly a safe material to employ in dwellings. Hydrocyanic acid gas has been used extensively in the last decade for the destruction of household pests. Directions for using it are given on page 42.

For the treatment of garments and furs stored during warm weather, see the discussion on page 24.

Silver fish, bristle tail or fish moth[1]

This peculiar, elusive insect is frequently the subject of inquiry by careful housekeepers. It is rather common about houses though rarely seen. It is about ½ of an inch long, silvery gray and tapering. Perfect specimens have very long antennae and three equally long appendages at the posterior extremity.

Habits. This insect feeds upon farinaceous matter such as the sizing of paper, starch, paste etc. It has even been known to eat off the face of museum labels to such an extent as to render them illegible. It thrives best in places where there is comparatively little disturbance and is therefore rarely numerous in houses having few crevices and no storeroom where articles are allowed to remain undisturbed for months or even years at a time.

Control measures. This insect, if abundant, can be controlled to best advantage, according to Mr Marlatt, by slipping into their haunts pieces of paper liberally treated with a thick, boiled, starchy paste poisoned with arsenic. This material should be used with extreme care and placed only where there is no danger of children getting hold of the poison. Ordinarily the dusting of this insect's haunts with fresh pyrethrum powder, followed by thorough cleaning, is preferable to the employment of an arsenical poison. Damage is most likely to occur in comparatively moist places or where articles are allowed to remain undisturbed for a year or more.

Book louse

This is a pale louselike insect[2] only $\frac{1}{25}$ of an inch long and frequently designated as the " death watch " because of the peculiar ticking sound it makes. This latter is supposed to predict an early death in the family. An allied species[3] has similar habits and is considered to be the true " death watch." Both of these species, as well as allied forms, live upon vegetable matter and occasionally may become very abundant. There have been several records of this insect issuing in enormous numbers from mattresses stuffed with hair, corn husks or straw. An infestation of this kind can be controlled best by removing and burning the infested mattress. The apartment then should be thoroughly cleaned.

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[1] Lepisma domestica Pack.
[2] Atropos divinatoria Fabr.
[3] Clothilla pulsatoria Linn.

White ants[1]

These insects, despite their general resemblance to the more common ants, are very different creatures. The flying ants, though having somewhat the same size as some of our winged, black ants, may be recognized at once by the numerous veins of the wings. White ants are frequently very injurious to buildings or their contents, particularly in Washington and to the southward. Occasionally they cause serious injuries in New York, and in at least one instance established themselves in safe deposit vaults and proceeded to destroy valuable records and to tunnel the wooden blocks of electrotypes. The whitish, wingless, antlike forms make large tunnels in woody and other vegetable fibers,

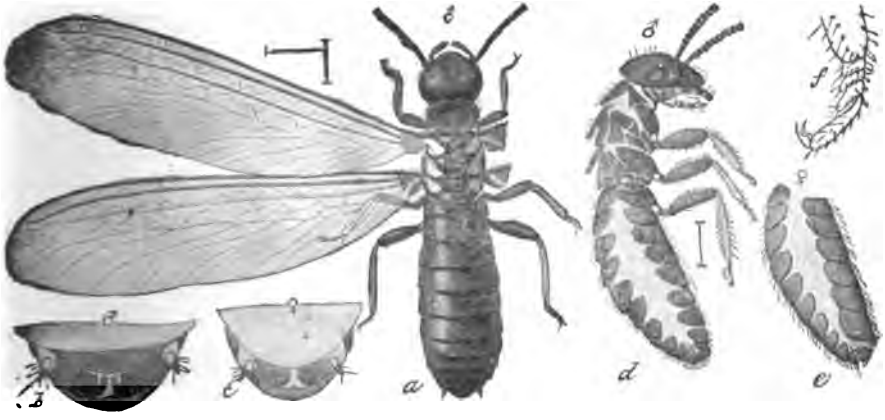

Fig. 18 White ants: *a*, adult male from above; *b*, posterior extremity of the same from below; *c*, the same of the female; *d*, male seen from the side; *e*, side view of the abdomen of the female; *f*, tarsus showing the segments and the claw; *a*, *d*, *e* are enlarged; *b*, *c*, *f* greatly enlarged. (After Marlatt, U. S. Dep't Agric. Div. Ent. Bul. 4. n. s. 1896)

invariably avoiding the light. They pass from one object to another only through covered galleries. The secrecy with which these pests operate enables them to cause extensive injury before their presence is suspected. These peculiar insects are familiar to many who have observed their operations in an old stump.

Control measures. Nothing but the most thorough work will clean a building or a vault of these insects, because their burrowing habits enable them to get beyond the reach of destructive gases. An infested vault should have everything removed, every crack and crevice thoroughly cleaned and then special attention given to doors or other means of entrance, to see that there is no possi-

[1] Termes flavipes Kollar.

bility of insects entering through an unsuspected crevice. Before replacing the contents of the vault, wood, papers or other materials likely to be infested should be most carefully examined and, if necessary, thoroughly heated or repeatedly fumigated with some gas. Great care should be exercised to prevent the reinfestation of any such place. It is even more difficult to control this pest in buildings, since if it becomes abundant nothing can be done aside from installing brick, stone or concrete foundations. This form of construction is especially advisable in warmer sections of the country. Where books, papers and exposed woodwork only are infested, thorough and protracted fumigation with hydrocyanic acid gas, described on page 42, may be advisable.

Crickets

These black, chirping, nocturnal insects[1] occasionally make their way into houses and for the most part are welcome. Sometimes they may cause serious injury. Dr Lintner records a case where a suit of clothes, just from the tailor, was completely ruined in a night by the common black field cricket[2] which had entered an open window in some numbers. Such injury is exceptional. Crickets can be destroyed where necessary by the use of ground-up carrots or potatoes to which a liberal amount of arsenic has been added. They may also be caught by taking advantage of their liking for liquids and placing low vessels containing beer or other fluids about their haunts.

WOOD PESTS

House ants

There are several species of ants likely to occur in houses. These little insects are not specially destructive nor obnoxious aside from their faculty of getting into everything.

The little red ant[3] is particularly troublesome, since its small size, it being only about $\frac{1}{16}$ of an inch long, enables it to enter almost any receptacle not hermetically sealed. Furthermore, this little pest is very prolific and occasionally literally overruns buildings to the serious discomfort of the inhabitants. This tiny species is perhaps the most common and the most abhorred of all, owing to the difficulty of eradicating it.

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[1] Gryllus domesticus Linn. and others.
[2] Gryllus luctuosus Serv.
[3] Monomorium pharaonis Linn.

The little black ant[1] is about ¼ of an inch long and though normally occurring under stones in yards, also invades the house in considerable numbers.

The pavement ant[2] is about ⅛ of an inch long and is very common along the Atlantic seaboard.

The large, black ant[3] is the giant among our household ants. It may be half an inch or more in length, is normally a wood feeder and has frequently been designated as the carpenter ant. This large species occasionally invades buildings, particularly in the country, lives in the timbers and makes systematic levys upon the food supplies of both kitchen and pantry. Occasionally this species may become very abundant in a dwelling.

Control measures. A house badly infested by ants, particularly if a rather old building, might well be thoroughly fumigated with

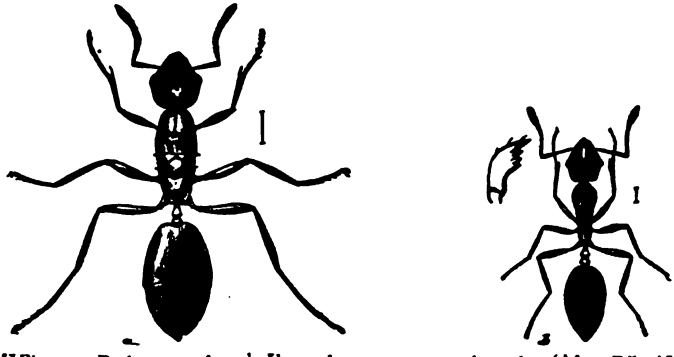

Fig. 19 Red ant: *a*, female; *b*, worker or neuter, enlarged. (After Riley)

hydrocyanic acid gas, directions for which are given on page 42. This method of treatment is especially good for the little red ant, because its nests are usually in the walls of the building and therefore inaccessible.

Aside from the fumigation mentioned above, the next most satisfactory method of controlling these pests is to search for their nests and destroy them so far as possible. This can be accomplished only by ascertaining the origin of the continuous stream of ants and is frequently impossible. The little black ant and the pavement ant are very likely to build nests outdoors under stones. Should the nests be found they can be destroyed by liberal applications of boiling water or spraying with kerosene.

[1] Monomorium minutum Mayr.
[2] Tetramorium caespitum Linn.
[3] Camponotus herculeanus Linn.

Outdoor nests of ants can be destroyed by the use of carbon bisulfid. Make a hole several inches deep with a broom handle and put therein about 1 ounce of carbon bisulfid and cover quickly. In the case of a large nest, several holes should be made at a distance of a foot or a foot and a half and each charged with carbon bisulfid. A more recent method is scooping out a portion of the soil and filling the cavity with a solution of cyanide of potassium, using 1 ounce of this deadly poison to a gallon of water. Another probably equally effective method is the sprinkling of the surface of the nest with fine particles of potassium cyanide. This material, it should be remembered, is a most dangerous poison and every precaution should be taken to avoid disastrous results. The nests of the large black ant are usually found in timbers, such as studding in the walls and are therefore wellnigh inaccessible. The writer has seen 2 x 4 joists badly riddled by the operations of this insect.

Trapping the ants by means of sponges dipped in sweetened water is frequently advised and gives good results if conscientiously carried out. First, attractive foods should be removed, so far as possible, prior to the distribution of the pieces of sponge saturated with sweetened water. These latter should be gathered from time to time and the ants clinging thereto destroyed by dropping in boiling water.

Cockroaches

Cockroaches and their smaller cousins, the croton bugs, are frequently the bane of the neat housekeeper, particularly in old city dwellings. These species are distributed through commercial agencies and have become well established in most large cities and villages on the principal routes of travel, especially seaports and places on rivers or canals, since these pests are invariably found on ships and boats. The old houses with their numerous inaccessible crannies and crevices afford a multitude of hiding places and enable the roaches to exist year after year, in spite of strenuous efforts to exterminate them.

Description. At least three species of cockroaches may be found in houses. The American cockroach[1] is a large, dark brown species nearly an inch and a half long and has well developed wings. The Oriental cockroach or black beetle[2] is a nearly wingless, dark brown or black form about an inch long. The Australian

[1] Periplaneta americana Linn.
[2] Periplaneta orientalis Fabr.

cockroach,[1] frequently brought to our shores by vessels, is a reddish brown form about an inch and a quarter long, easily recognized by the yellow, irregular, oval markings just behind the head. A slender, light green cockroach[2] about an inch long is occasionally introduced with tropical fruits. The smallest and the most pestiferous of all is the croton bug,[3] a light brown, dark marked cockroach only about ¾ of an inch in length.

Habits. The larger American or European cockroaches are frequently somewhat abundant, but the most numerous is the smaller croton bug. These insects find the dampness of water pipes very congenial, and on account of their abundance in such places, they are widely known as water bugs. Roaches, both large and small,

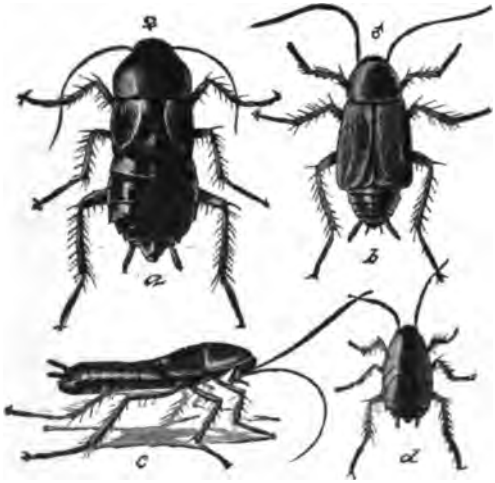

Fig. 20 Oriental cockroach: *a* and *c*, female from above and the side: *b*, male; *d*, a half grown individual; all natural size. (After Marlatt, U. S. Dep't Agric. Div. Ent. Bul. 4. n. s. 1896)

feed upon a variety of vegetable and animal matter. The refuse scraps of the sink, the food on the pantry shelves, woolens, leather of shoes, furniture or books, the sizing or paste of cloth-bound books and similar materials are all liable to be gnawed by these almost omnivorous pests. Aside from the actual amount of injury inflicted, the fetid, roachy odor is imparted to infested food stuffs. It is only fair to state that these disgusting pests are known to feed upon that horror of the housewife, the bedbug. There is small choice between the two evils.

[1] Periplaneta australasiae Linn.
[2] Panchlora hyalina Stahl.
[3] Ectobia germanica Linn.

Control measures. Badly infested houses can be cleared of these pests most easily by thorough and perhaps repeated fumigations with hydrocyanic acid gas as described on page 42. Carbon bisulfid, has also been advised as a fumigant. On account of the inflammability of the latter, we would prefer to use in houses the somewhat more poisonous hydrocyanic acid gas. Carbon bisulfid with its heavy fumes is particularly adapted to the destruction of these pests in the holds of vessels.

A still safer method of fumigation consists in burning pyrethrum in infested compartments. It is stated that the vapors of this insecticide are frequently more effective in destroying roaches than the use of the powder itself. The room should be kept closed from six to ten hours. The smoke of burning gunpowder is also very obnoxious and deadly to roaches, particularly the black English roach. The moistened powder should be molded into

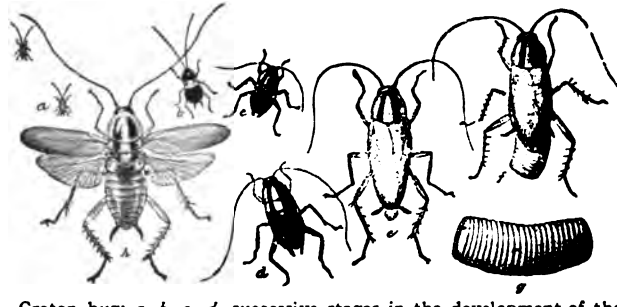

Fig. 21 Croton bug: *a*, *b*, *c*, *d*, successive stages in the development of the young; *e*, adult; *f*, female, with egg case; *g*, egg case enlarged; *h*, adult, with wings spread; all natural size except *g*. (After Riley)

cones, placed in an empty fireplace and ignited. It is particularly valuable in the case of old houses.

There are a number of roach poisons placed upon the market and some of these are undoubtedly very efficacious, particularly if assisted by persistent cleanliness and the eradication of inaccessible haunts, so far as possible. We would further suggest the testing of naphthalene in the flake form, as described on page 20, as a means of at least partially suppressing this pest. The liberal use of Persian insect powder or pyrethrum is also of service in destroying these insects. The paralyzed cockroaches should be swept up and burned.

A relatively simple method, described by Mr Tepper of Australia, is to mix plaster of paris one part, and flour three or four

parts, in a saucer and place the preparation about the haunts of the pests. Near by there should be a saucer containing a little water and made easily accessible to the roaches, by laying a few sticks as bridges up to the rim. The insects eat the mixture, drink the water and soon succumb.

There are several methods of trapping cockroaches, particularly the larger species. A deep vessel partially filled with stale beer or ale can be placed in roach haunts and small sticks adjusted so that the insects can crawl over the edge and to within a short distance from the surface of the liquid. The pests fall into the trap and, being unable to escape, are drowned in large numbers. This method is of comparatively little service with the smaller, more wary croton bug.

Larder beetle[1]

The parent insect, a stout, dark brown beetle with the base of the wing covers mostly yellowish, is frequently rather common about houses in May and June. This insect breeds by preference on animal matter such as ham, bacon, various meats, old cheese, horns, hoofs etc. The very hairy, brown grub is about half an inch long when full grown.

Fig. 22 Larder beetle, seen from above, enlarged. (Original)

Meats and other food stuffs attractive to this insect should be stored in places inaccessible to the beetles. It is said that old cheese can be used very successfully for trapping the parent insects. Cheese or meat infested by the grubs should have the affected part cut away and the surface washed with a very dilute carbolic solution. The packing of meats in tight bagging is of considerable service in preventing attack.

Cheese skipper

The cheese skipper[2] is the young of a small, black, glistening fly about $\frac{3}{16}$ of an inch long. The white, cylindric maggots are easily recognized by their peculiar jumping power. This is accomplished by bringing the two ends of the body together and then suddenly

[1] Dermestes lardarius Linn.
[2] Piophila casei Linn.

straightening with a quick muscular action. The maggots of this insect are likely to occur on cheese, particularly that which has been kept for some time, and also upon ham. This species has proved to be a serious pest in some packing houses. It is more or less abundant about cheese factories.

This little pest can be best controlled by storing products likely to be injured, in a dark place. Scrupulous cleanliness is a most efficient preventive. Rubbing daily the bandages and sides of cheese, in hot weather, has been recommended for the purpose of destroying or brushing off eggs. The cheese may be washed with hot whey or with lye, the latter acting as a repellent. Smoked meats should be put in places inaccessible to the flies. A fine screen, 24 to the inch wire mesh, effectively excludes this little insect.

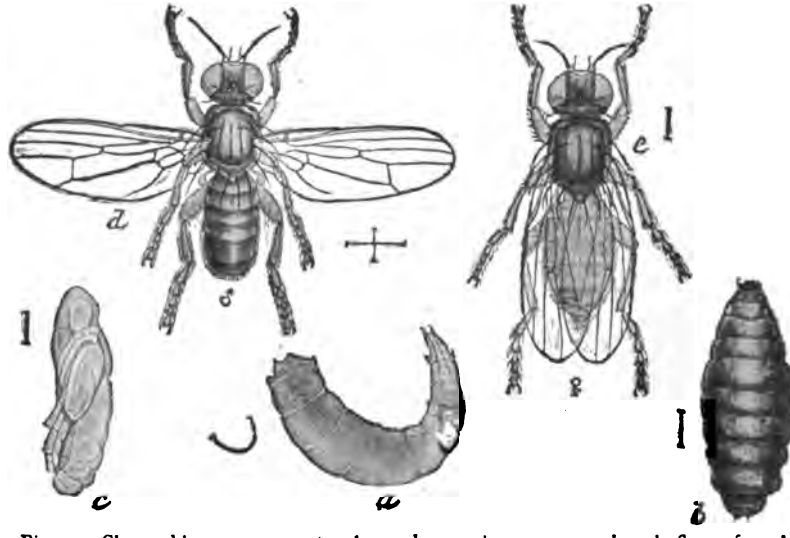

Fig. 23 Cheese skipper: *a*, maggot or larva; *b*, puparium; *c*, pupa; *d*, male fly; *e*, female; all enlarged. (After Howard, U. S. Dep't Agric. Div. Ent. Bul. 4. n. s. 1896)

Cheese or meat infested by skippers is not necessarily ruined, since the injured parts can be cut out and the remainder used as food.

Cereal and seed pests

A number of these insects are likely to occur in houses and, on account of their somewhat similar habits, they are discussed under a general head. Most of these species are important because of their infesting cereals or cereal preparations of one kind or another.

The Indian meal moth[1] is one of the more common of these species. The whitish, brown-headed caterpillar lives in a large variety of substances, including all cereal preparations and such diverse materials as various nuts, dried fruits, seeds etc. The caterpillar spins a light web to which particles of its food and frass adhere. The parent moth is reddish brown, with a coppery luster and has a wing spread of about $\frac{3}{4}$ of an inch.

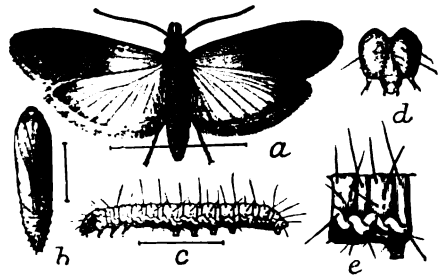

Fig. 24 Indian meal moth: *a*, moth; *b*, pupa; *c*, caterpillar from the side; *d*, head and *e*, first abdominal segment of caterpillar, more enlarged. (After Chittenden, U. S. Dep't Agric. Div. Ent. Bul. 4. n. s. 1896)

The meal snout moth[2] subsists mostly upon cereals though it has been recorded as feeding upon other seeds and dried plants

Fig. 25 Meal snout moth: *a*, adult; *b*, larva; *c*, pupa in its cocoon; twice natural size. (After Chittenden, U. S. Dep't Agric. Div. Ent. Bul. 4. n. s. 1896)

and displaying a preference for clover. The whitish caterpillars live in long, silken tubes.

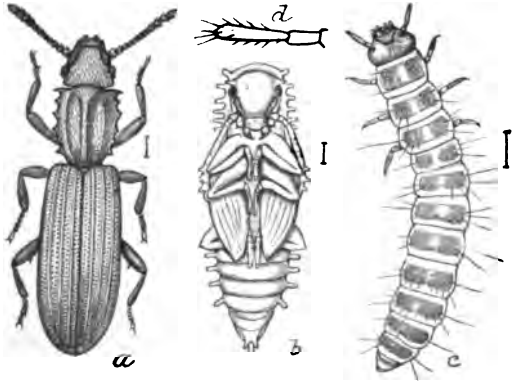

Fig. 26 Saw-toothed grain beetle: *a*, beetle from above; *b*, pupa, from below; *c*, grub or larva; all enlarged. (After Chittenden, U. S. Dep't Agric. Div. Ent. Bul. 4. n. s. 1896)

[1] Plodia interpunctella Hubn.
[2] Pyralis farinalis Linn.

The saw-toothed grain beetle[1] is one of the smallest and most persistent of the grain beetles. It is only about $\frac{1}{10}$ of an inch long, reddish brown, flattened and easily recognized by the peculiar saw edge along the sides of the thorax. This species displays a marked preference for all cereal preparations though it occurs in preserved fruits, nuts and seeds and has been recorded as injuring yeast cakes, mace, snuff and even red pepper. This species will breed for extended periods in packages of cereals. The writer had his attention called recently to a case where this beetle multiplied by the millions in a brewery, spread therefrom to adjacent houses and caused a great deal of annoyance by getting into everything, not excepting clothing that was worn and bedding in use.

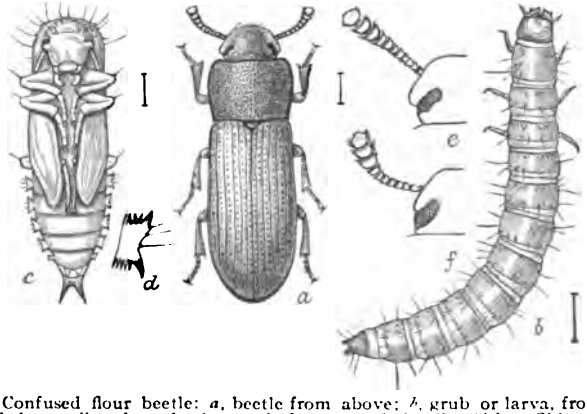

Fig. 27 Confused flour beetle: *a*, beetle from above; *b*, grub or larva, from above; *c*, pupa, from below; all enlarged; *d*, *e*, and *f* structural details. (After Chittenden, U. S. Dep't Agric. Div. Ent. Bul. 4. n. s. 1896)

The confused flour beetle[2] is a stout, rust-red beetle about $\frac{1}{6}$ of an inch long. It, like the preceding form, has a marked liking for cereal preparations, though it occurs in such diverse products as ginger, cayenne pepper, baking powder, orris root, snuff, slippery elm, peanuts and various seeds. A closely allied form with similar habits, known as the rust-red flour beetle[3] occurs mostly in the Southern States.

The meal worms[4] are rather common pests of meal and the ordinary stable foods. The large, brown or dark brown parent beetles have a length of about $\frac{5}{8}$ of an inch and are frequently

[1] Silvanus surinamensis Linn.
[2] Tribolium confusum Duv.
[3] Tribolium ferrugineum Fabr.
[4] Tenebrio obscurus Linn. and T. molitor Linn.

found about houses. The young or larvae are an inch or more in length, cylindric and yellowish brown.

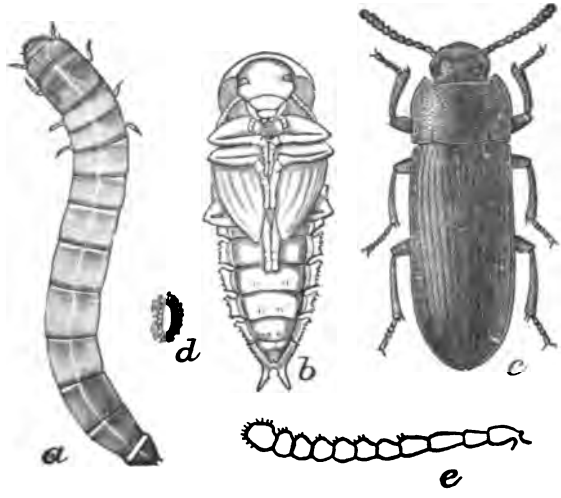

Fig. 28 Meal worm: *a*, larva; *b*, pupa; *c*, female beetle; *d*, egg, with surrounding case; *e*, antenna. *a*, *b*, *c*, *d*, about twice natural size, *e*, more enlarged. (After Chittenden, U. S. Dep't Agric. Div. Ent. Bul. 4. n. s. 1896)

The cadelle[1] is another inhabitant of grain bins. The beetle is rather stout, shining dark brown and about ⅜ of an inch long. The peculiar grub or larva, over an inch long, is easily recognized

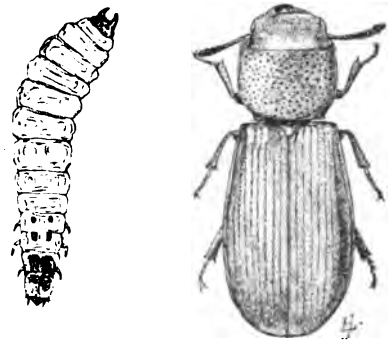

Fig. 29 Cadelle, beetle and larva, from above, enlarged. (Original)

by its flattened appearance and the dark brown plates just behind the head and at the opposite extremity of the body.

[1] Tenebrioides mauritanicus Linn.

The drug store beetle[1] is a rather stout, light brown beetle about ⅛ of an inch long, which attacks a large variety of substances. It occurs in mills, granaries and warehouses, living upon flour, meal, breakfast foods, condiments, roots and herbs and animal sub-

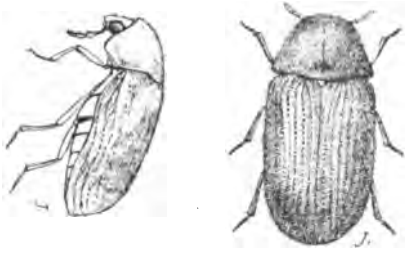

Fig. 30 Drug store beetle, seen from above and the side, enlarged. (Original)

stances. It has even been known to colonize itself in a human skeleton which had been dried with the ligaments left on, and has been recorded as perforating tinfoil and sheet lead.

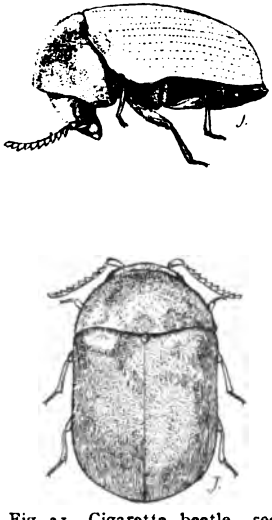

Fig. 31 Cigarette beetle, seen from above and the side, enlarged. (Original)

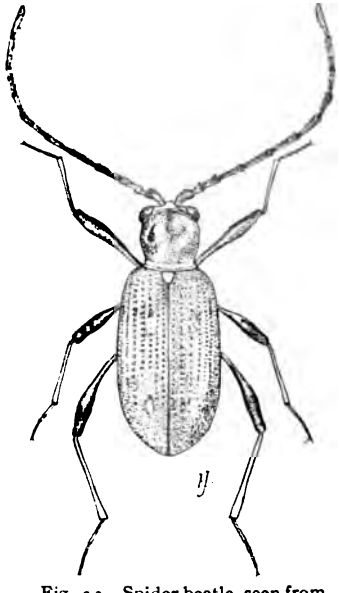

Fig. 32 Spider beetle, seen from above, enlarged. (Original)

The cigarette beetle[2] is another tiny omnivorous species. The beetle is light brown, stout, slightly hairy and only ⅛ of an inch long. It infests a large variety of food stuffs, including condi-

[1] Sitodrepa panicea Linn.
[2] Lasioderma serricorne Fabr.

ments, drugs of various kinds and dried herbarium specimens. It is best known on account of its work in tobacco, cigarettes in packages being frequently perforated by this tiny pest.

Spider beetles. The white marked spider beetle[1] is a small, reddish brown form with four white marks on its wing covers. Its long antennae and legs and subglobular body are suggestive of a spider, hence the common name. This species feeds upon a large variety of dried vegetable and animal substances, such as insect collections, dried plants and herbaria, red pepper, cotton seed, refuse wool, and is said to be injurious to furs, clothing, roots, grain, stuffed animals, etc. The brown spider beetle[2] lives with the preceding, has similar habits and differs principally in the absence of the white markings.

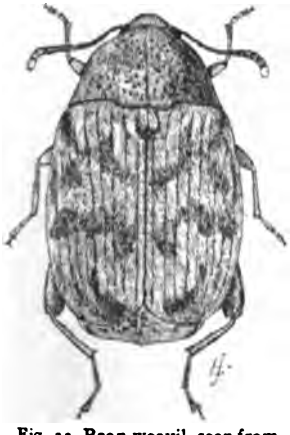

Fig. 33 Bean weevil, seen from above, enlarged. (Original)

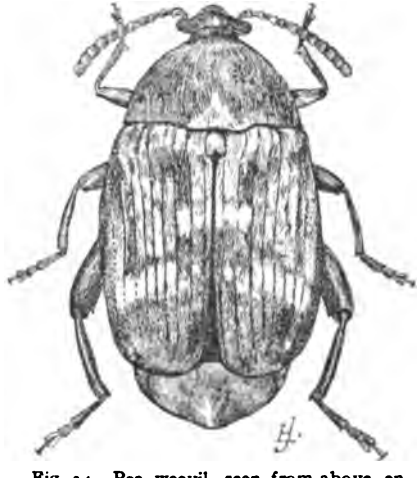

Fig. 34 Pea weevil, seen from above, enlarged. (Original)

The pea weevil[3] and various bean weevils[4] are stout, grayish weevils most easily recognized by their occurring respectively in peas and beans. The original infestation usually occurs in the field, though these insects are capable of breeding for extended periods in the dried seeds of their food plants.

Control measures. It is comparatively easy, with the exercise of a moderate degree of care, to avoid serious injury by any of

[1] Ptinus fur Linn.
[2] Ptinus brunneus Duft.
[3] Bruchus pisorum Linn.
[4] B. obtectus Say and others.

these pests, since they invariably require access to a liberal amount of food for an extended period. Any materials likely to produce numbers of these insects should not be allowed to lie undisturbed and accessible for a series of months. Most of these pests can easily be destroyed by heating the infested material to about 125 or 150 degrees Fahrenheit. This should be done carefully and time enough given so that the heat will penetrate and destroy all of the insects. Anything infested should be promptly cared for either by destroying the entire package or treating the same with fumes of carbon bisulfid.

Fumigation with carbon bisulfid is comparatively easy of execution since it is only necessary to put the material in a tight pail or can, put on the top a spoonful or thereabouts of the insecticide in a shallow saucer or plate, cover the receptacle tightly and allow the whole to stand for preferably 24 or 36 hours. This insecticide may be used on a large scale according to Dr W. E. Hinds, at the rate of 3-5 pounds to 1000 cubic feet of space.

FUMIGATION WITH HYDROCYANIC ACID GAS

This is one of the most effective methods of destroying insects in houses, particularly if the infestation is general. It should be remembered at the outset that potassium cyanide, sulfuric acid and their derivative, hydrocyanic acid gas, are among our most active and deadly poisons. They should be handled with extreme care and every precaution taken to avoid an accident, since a slight mistake might result in one or more fatalities.

One ounce of high grade, 98% cyanide of potassium and one fluid ounce of the best commercial sulfuric acid, diluted with two fluid ounces of water, should be used for every 100 cubic feet of space. These amounts should be doubled for poorly constructed houses. The fumigation should last at least 30 minutes and it would be preferable to have it continue three or four hours, or if feasible, all night.

Prior to treatment all fluids, especially liquid or moist foods, should be removed from the house. Arrangements should be made to open the building from the outside after the fumigation is completed. Windows and doors should be sealed as tightly as possible, either by stuffing damp paper in the crevices or pasting strips of paper over cracks. Chimney places, ventilators and other orifices should be closed tightly. The gas is generated by dropping

the cyanide of potassium, previously broken into lumps about the size of a walnut and preferably placed in thin bags or wrapped loosely in thin paper, into the requisite amount of diluted acid. The acid should be carefully diluted by pouring it slowly, accompanied by frequent stirring, into the necessary amount of water. This dilution should be slow enough to avoid all danger of this very strong acid splashing and perhaps causing dangerous burns. It will be found advisable to have one or more jars or generators in each room or hallway, since it is not wise to use more than two pounds of cyanide in a generator. The large, preferably deep, earthenware vessels used as generators should be placed near the middle of the room and on a thick layer of newspapers in order to avoid possible injury from splashing acid. Precautions should be observed, if the building is in contact with others in a row, to see that parties in adjacent dwellings are warned and arrangements made so that the rooms next the treated building will be kept well aired during the fumigation. It is unsafe to attempt to fumigate individual rooms in a house or a building in a row, unless one can be certain that there will be good aeration on all sides of the apartment or building. The deadly character of this gas is shown by the destruction of sparrows resting upon the eaves of a building during fumigation. One should not attempt to fumigate a building or a room alone, because an accident under such conditions is very likely to result fatally. Since hydrocyanic acid gas is lighter than air, operations should commence at the top of the building and proceed successively from floor to floor. Better still, place the requisite amount of the cyanide of potassium in thin bags, suspend each over its generator in such a manner that when a string near the exit is loosened, all will drop into the jars. The poison should not be in a thick paper bag, as the action of the acid may be seriously hindered if not almost prevented.

Under no conditions should any one be allowed to enter the building prior to the completion of the fumigation and its thorough aeration. At least 30 minutes and preferably an hour or more, depending somewhat upon the means of ventilation, should be allowed for this latter process. It is unsafe to enter any recently fumigated building until all the odor of the gas, resembling that of peach kernels, has disappeared. The contents of the fumigating jars should be carefully disposed of together with any remaining cyanide. These substances can either be buried deeply in the soil, or if in a city, may be poured into the sewer.

The following memoranda will doubtless prove of service in practical work.

1 Estimate the cubical contents and the amount of materials for each room.
2 Remove all liquids and moist foods in particular.
3 Seal all exits tightly with strips of paper or by filling crevices.
4 Provide for ventilation from the outside.
5 Weigh out the cyanide and place it in thin bags or do it up loosely in thin paper.
6 Place the generators in the various rooms, each upon a thick layer of newspapers.
7 Dilute the acid carefully and put it in the generators.
8 Distribute the amounts of cyanide to the various rooms.
9 Be certain that everything is all right and nobody in the building or room. *Notify* occupants of adjacent rooms or houses that the fumigation is to be commenced.
10 Drop in the cyanide, preferably from near the exit and close tightly.
11 Adopt suitable precautions to prevent the room or building being entered during the fumigation period.
12 Open the ventilators from the outside.
13 After the building has been thoroughly aerated, remove the generators and take care of their contents together with any excess of cyanide.

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New York State Education Department

New York State Museum

JOHN M. CLARKE, Director

PUBLICATIONS

Packages will be sent prepaid except when distance or weight renders the same impracticable. On 10 or more copies of any one publication 20% discount will be given. Editions printed are only large enough to meet special claims and probable sales. When the sale copies are exhausted, the price for the few reserve copies is advanced to that charged by second-hand booksellers, in order to limit their distribution to cases of special need. Such prices are inclosed in [ ]. All publications are in paper covers, unless binding is specified. Checks or money orders should be addressed and payable to New York State Education Department.

Museum annual reports 1847–date. *All in print to 1894, 50c a volume, 75c in cloth; 1894–date, sold in sets only; 75c each for octavo volumes; price of quarto volumes on application.*

These reports are made up of the reports of the Director, Geologist, Paleontologist, Botanist and Entomologist, and museum bulletins and memoirs, issued as advance sections of the reports.

Director's annual reports 1904–date.

1904. 138p. 20c.
1905. 102p. 23pl. 30c.
1906. 186p. 41pl. 35c.
1907. 212p. 63pl. 50c.

These reports cover the reports of the State Geologist and of the State Paleontologist. Bound also with the museum reports of which they form a part.

Geologist's annual reports 1881–date. Rep'ts 1, 3–13, 17–date, O; 2, 14–16, Q.

In 1898 the paleontologic work of the State was made distinct from the geologic and was reported separately from 1899–1903. The two departments were reunited in 1904, and are now reported in the Director's report.

The annual reports of the original Natural History Survey, 1837–41, are out of print.

Reports 1–4, 1881–84, were published only in separate form. Of the 5th report 4 pages were reprinted in the 39th museum report, and a supplement to the 6th report was included in the 40th museum report. The 7th and subsequent reports are included in the 41st and following museum reports, except that certain lithographic plates in the 11th report (1891) and 13th (1893) are omitted from the 45th and 47th museum reports.

Separate volumes of the following only are available.

Report	*Price*	*Report*	*Price*	*Report*	*Price*
12 (1892)	$.50	17	$.75	21	$.40
14	.75	18	.75	22	.40
15, 2v.	2	19	.40	23	.45
16	1	20	.50	[*See* Director's annual reports]	

Paleontologist's annual reports 1899–date.

See first note under Geologist's annual reports.

Bound also with museum reports of which they form a part. Reports for 1899 and 1900 may be had for 20c each. Those for 1901–3 were issued as bulletins. In 1904 combined with the Director's report.

Entomologist's annual reports on the injurious and other insects of the State of New York 1882–date.

Reports 3–20 bound also with museum reports 40–46, 48–58 of which they form a part. Since 1898 these reports have been issued as bulletins. Reports 3–4, 17 are out of print, other reports with prices are:

Report	*Price*	*Report*	*Price*	*Report*	*Price*
1	$.50	10	$.35	18 (Bul. 64)	$.20
2	.30	11	.25	19 (" 70)	.15
5	.25	12	.25	20 (" 97)	.40
6	.15	13	*Free*	21 (" 104)	.25
7	.20	14 (Bul. 23)	.20	22 (" 110)	.25
8	.25	15 (" 31)	.15	23 (" 124)	.75
9	.25	16 (" 36)	.25		

Reports 2, 8–12 may also be obtained bound in cloth at 25c each in addition to the price given above.

Botanist's annual reports 1867–date.

Bound also with museum reports 21–date of which they form a part; the first Botanist's report appeared in the 21st museum report and is numbered 21. Reports 21–24, 29, 31–41 were not published separately.

Separate reports for 1871–74, 1876, 1888–98 are out of print. Report for 1899 may be had for 20c; 1900 for 50c. Since 1901 these reports have been issued as bulletins.

Descriptions and illustrations of edible, poisonous and unwholesome fungi of New York have also been published in volumes 1 and 3 of the 48th (1894) museum report and in volume 1 of the 49th (1895), 51st (1897), 52d (1898), 54th (1900), 55th (1901), 56th (1902), 57th (1903), 58th (1904), 59th (1905) and 60th (1906) reports. The descriptions and illustrations of edible and unwholesome species contained in the 49th, 51st and 52d reports have been revised and rearranged, and, combined with others more recently prepared, constitute Museum memoir 4.

Museum bulletins 1887–date. O. *To advance subscribers, $2 a year or $1 a year for division (1) geology, economic geology, paleontology, mineralogy; 50c each for divisions (2) general zoology, archeology and miscellaneous, (3) botany, (4) entomology.*

Bulletins are grouped in the list on the following pages according to divisions.

The divisions to which bulletins belong are as follows:

1 Zoology
2 Botany
3 Economic Geology
4 Mineralogy
5 Entomology
6 "
7 Economic Geology
8 Botany
9 Zoology
10 Economic Geology
11 "
12 "
13 Entomology
14 Geology
15 Economic Geology
16 Archeology
17 Economic Geology
18 Archeology
19 Geology
20 Entomology
21 Geology
22 Archeology
23 Entomology
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33 Zoology
34 Paleontology
35 Economic Geology
36 Entomology
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38 Zoology
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41 Archeology
42 Paleontology
43 Zoology
44 Economic Geology
45 Paleontology
46 Entomology
47 "
48 Geology
49 Paleontology
50 Archeology
51 Zoology
52 Paleontology
53 Entomology
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82 "
83 Geology
84 "
85 Economic Geology
86 Entomology
87 Archeology
88 Zoology
89 Archeology
90 Paleontology
91 Zoology
92 Paleontology
93 Economic Geology
94 Botany
95 Geology
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97 Entomology
98 Mineralogy
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100 Economic Geology
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129 Entomology

Bulletins are also found with the annual reports of the museum as follows:

Bulletin	*Report*	*Bulletin*	*Report*	*Bulletin*	*Report*	*Bulletin*	*Report*
12–15	48, v. 1	66, 67	56, v. 4	92	58, v. 3	117	60, v. 3
16, 17	50, v. 1	68	56, v. 3	93	58, v. 2	118	60, v. 1
18, 19	51, v. 1	69	56, v. 2	94	58, v. 4	119-21	61, v. 1
20–25	52, v. 1	70, 71	57, v. 1, pt 1	95, 96	58, v. 1	122	61, v. 2
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